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(54) Gasket Material

(57) Heat-resistant non-asbestos gasket sheet material having a matrix of cured hydraulic cement which is reinforced by vitreous fibres and organic web-forming fibres and incorporates a micaceous mineral, said material having a density in the range 700—1200 kg/m³, a tensile strength of at least 2 MPa and a burst strength of at least 50 KPa.

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SPECIFICATION

Heat-resistant Gasket Sheet Material

This invention relates to heat-resistant gasket sheet material, and in particular to such material as is suitable for use as replacement for the asbestos-containing material which is currently used in the construction of motor vehicle cylinder head gaskets.

Asbestos-containing material of the type just referred to is commonly made in the form of sheet of thickness 0.5—2.5 mm, and has a matrix of cured hydraulic cement which is reinforced with asbestos fibres. It is made on conventional board-making machinery such as the Hatschek machine, and in the manufacturing process an aqueous slurry of the ingredients which are to compose the product is de-watered on a water-permeable conveyor. The sheet thus formed is set aside for the cement to cure, or is treated to speed up curing of the cement.

The present invention provides a non-asbestos alternative to the heat-resistant gasket sheet material just described, having tensile strength and burst strength approaching those of the known asbestos products.

According to the invention, heat-resistant non-asbestos gasket sheet material has a matrix of cured hydraulic cement which is reinforced by vitreous fibres and organic web-forming fibres and incorporates a micaceous mineral, said material having a density in the range 700—1200 kg/cm^3, a tensile strength of at least 2MPa and a burst strength of at least 50KPa.

A preferred range for the content of hydraulic cement is 30—45% by weight. The hydraulic cement is suitably ordinary Portland cement, fine ground (and therefore rapid-hardening) Portland cement or high alumina cement.

The reinforcement of the cured cement matrix is provided by both the vitreous fibres and the organic fibres, although the latter have, as indicated, the additional function of forming a web during formation of the sheet material on conventional board-making machinery, and so preventing the escape of an unduly high proportion of hydraulic cement through the water-permeable conveyor. The web-forming fibres are preferably of cellulose (for example, wood, jute or sisal), but may be polyethylene or polypropylene fibres of the kind commercially available under the trade mark Pulpex. The organic web-forming fibres suitably from 2—7% by weight of the sheet material.

The vitreous fibres, which are suitably employed in lengths up to about 15mm, may for example be of mineral wool or the so-called alkali-resistant glass fibres such as those made with a content of combined zirconia. The vitreous fibres suitably form 10—30% by weight of the sheet material.

The function of the micaceous mineral ingredient of the sheet is to confer improved heat-resistance. The mineral may be a mica proper (such as muscovite, or the phlogopite mica recommended for fire-retardant and heat insulation applications by Locke et al in their paper "Suzorite Mica" delivered at the First Industrial Minerals International Congress held in London in July 1974). Alternatively, it may be delaminated exfoliated vermiculite, or a chlorite. All these minerals contain infinite two-dimensional negatively charged complex metal-silicate ions. The mineral is employed in the ordinary finely divided state, and should not be so further ground that the plate-like structure of its particles is destroyed. The micaceous mineral suitably forms 2—20% by weight of the sheet material.

To avoid degradation of the vitreous fibre content of the sheet material by lime which is slowly released in the cured cement of the matrix, it will ordinarily be desired to make the material with a substantial content of free silica, such as is provided by pulverised fuel ash, to react with the lime. Pulverised fuel ash is suitably present in an amount forming 15—35% by weight of the sheet material. Other sources of free silica can be used in an equivalent proportion.

The sheet material is preferably made with a content of ball clay, suitably at a level of 5—20% by weight, to assist formation during the dewatering step and to confer green strength between the steps of dewatering and curing. A small content of rayon fibres, suitably in the range 0.1—1% by weight, is also useful as reinforcement for the sheet at that stage.

The invention is further illustrated by the following Example.

Example

1. Bleached softwood sulphate pulp was made into an aqueous slurry of solids content 8% by weight and freeness 65° Schopper Riegler.

2. An amount of the slurry of (1) containing 5 kg of wood cellulose fibres was added to 1000 litres of water at 30—35°C, and to this vigorously stirred diluted slurry were added pozzolanic pulverised fuel ash (25kg; 85% passing a sieve of aperture 45μm), ball clay (8kg; 90% passing a sieve of aperture 5μm), and mica (5kg; 98% passing a sieve of aperture 250μm). The slurry was agitated vigorously for 10 minutes.

3. Rayon fibres (0.5kg; 3 denier; chopped to 6mm fibre length) and mineral wool (16.5kg) were added to the slurry of (2) with vigorous agitation during 3 minutes.

4. Water (200 litres) was added to the slurry of (3), followed by rapid hardening Portland cement (40kg; rapid hardening because of its fineness, not by virtue of any added accelerating agent).

5. After 5 minutes slow stirring, the slurry of (4) was made into sheet in an entirely conventional way on a Hatschek machine. (By this, the slurry is progressively dewatered as it travels on the water-permeable conveyor of the machine, and the dewatered material is formed into a laminate by winding it onto the cylindrical bowl of the machine. Once the laminate has

attained the desired thickness, it is removed by a cutter, and laid flat to form sheet).

6. The sheet material resulting from (5) was set aside to harden for 1-1/2—2-1/2 hours at ambient temperature and humidity, and then lightly calendered. The sheet (thickness 1 mm) was then heated for 16 hours in an air-circulation oven (air temperature, 95°C) to speed up curing. The product had density=1066kg/m^3, tensile strength=4.2MPa (machine direction) and 3.8MPa (cross direction) and burst strength (determined according to British Standard 3137 of 1959)=176KPa (=1.8kg/cm^2).

The sheet satisfactorily passed the following test:

Four specimens 50mm x 230mm are cut from the sheet with the long edge parallel to the direction of the grain i.e. in the fibre-orientation or machine direction. The specimens are suspended over a bath of water at room temperature. They are then lowered into the water so that they are immersed to a depth of 150mm. The water is brought to boiling point and kept at that temperature for 30 minutes, the level of water being kept constant by addition of boiling water as necessary. The specimens are then removed and inspected to confirm that they show no signs of disintegration.

Copper-clad cylinder head gaskets constructed in the conventional way except that they were made with sheet material prepared according to the above example instead of the conventional asbestos-containing gasket sheet material had a life not substantially different from the 'asbestos gaskets' when used on engines running at 300°C.

Claims

1. Heat-resistant non-asbestos gasket sheet material having a matrix of cured hydraulic cement which is reinforced by vitreous fibres and organic web-forming fibres and incorporates a micaceous mineral, said material having a density in the range 700—1200 kg/m^3, a tensile strength of at least 2MPa and burst strength of at least 50KPa.

2. Material according to claim 1, in which the organic web-forming fibres are cellulose fibres.

3. Material according to claim 1 or 2, in which the vitreous fibres are of mineral wool.

4. Material according to claim 1, 2 or 3, in which the micaceous mineral is mica itself.

5. Material according to any one of claims 1 to 4, which contains free silica.

6. Material according to any one of claims 1 to 5, which incorporates ball clay.

7. Material according to any one of claims 1 to 6, which incorporates rayon fibres.

8. Material according to any one of claims 1 to 7, in which the cement is Portland cement.

9. Material according to any one of claims 1 to 8, in which the weight proportions of the various ingredients are:—

Hydraulic cement	30—45%
Vitreous fibres	10—30%
Organic web-forming fibres	2—7%
Micaceous mineral	2—20%

10. Material according to claim 9, having a content of pulverised fuel ash forming 15—35% by weight of the sheet.

11. Material according to claim 9 or 10, having a content of ball clay forming 5—20% by weight of the sheet.

12. Material according to any one of claims 9 to 11, having a content of rayon fibres forming 0.1—1% by weight of the sheet.

13. Heat-resistant non-asbestos gasket sheet material according to claim 1 substantially as described with the reference to the Example herein.

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